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## Article

# Application of Quantitative Computer-Based Analysis for Student's Learning Tendency on the Efficient Utilization of Mobile Phones during Lecture Hours

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**Abstract:** The rapid pace of development and technology enhancements revolutionize the way people communicate and subsequently exert a considerable influence on a student's involvement and motivation. Mobile phones are considered among the most important devices to have made a breakthrough in every aspect of human life. Students' persistence in using mobile phones during classroom hours has become a significant concern because of distractions, disruptions, cheating, and inappropriate use. The objective of this paper is to identify the reasons why students use mobile phones during lecture hours by quantitative computer-based analysis. The participants were 520 undergraduate students who completed a questionnaire that is significantly based on the comparison of three principal perceptions of age, gender, and grades. To investigate the reliability of the proposed factors, Cronbach's alpha parameter was adequately utilized in this study to check the consistency adaptation of these factors and to provide questions on the questionnaire. To validate the measurement scales, qualitative content validity was taken into consideration. The analysis of the correlation matrix that is based on the six administered variables in this study has been conducted in the statistic correlation level of 0.01, which is ranged from 0.043 to 0.601. Although no statistically significant differences were found in the students' perception regarding their gender and age, the differences were significant regarding their grades as far as the addiction reason was concerned. Consequently, the overwhelming majority of the students tended to use mobile phones during the lecture hours for class-related purposes.

**Keywords:** mobile learning; Cronbach's alpha parameter; undergraduate university students; classroom; correlation matrix

## 1. Introduction

In the coming decades, there will be a sense of urgency for individuals to foster a deeper understanding of new experiences and views as a significant part; in this respect, information and communication technologies offer a window of chances to people to surpass their intelligence [1,2]. Information and communication technologies (henceforth; ICT) have played a significant role in the fast-changing and competitive societies for individuals to adapt to a world with accelerating technological change. The profound impact of ICT in education has been widely reported in the literature to empower instructors, modify the educational structures, foster student-centered learning, enhance the quality of education, and improve teaching skills. This is why the current systems of teaching and learning are looking for better teaching and learning technologies [3–6]. Moreover, the widespread application and popularity of ICT have significantly modified traditional teaching and learning approaches and, subsequently, many further studies have been made to indicate the dominant

influence of integrated technologies on learning outcomes [7–9]. Examining why students adhere to technological tools is of importance to analyze their reflection on the theories which are underpinning today's classroom. Student-centeredness, the dominant approach in 21st century classrooms, which has emerged from the constructivist theory, perceives meaningful learning as the product of experiential learning. Hence, students take responsibility for their learning processes and construct new knowledge upon their previous experiences quickly [10,11]. Furthermore, meaningful learning is also considered as the efficient adaptation of environmentally friendly classes by using advancement facilities like mobile phones, which they use to provide torrents of information in learning comprehensive knowledge of science-based technologies [12,13]. In other words, it is of significance for students to understand the world's phenomena so they can associate the new knowledge to the previously built knowledge [14].

Meaningful learning is the product of engagement in authentic learning activities in which students can cooperate to find solutions to real-world problems [15–18]. Furthermore, ICT can foster situated learning for students in real-world learning scenarios which incorporate both real and digital learning resources. It is argued that the new learning scenarios created by digital tools may be too complicated for students and do not lead to any learning achievements at the beginning [19]; however, provision of meta-cognitive strategies as well as awareness-raising can enhance students' learning and creative capabilities, and can help them cope with the demands of the e-learning environments [20–22]. In the contemporary era, mobile phones in particular smartphones, doubtlessly play a substantial role in every aspect of human life. Furthermore, Smartphones, as the most frequently used mobile devices, are not only utilized for individual engagement in exciting activities such as net-surfing, playing games, and sharing multi-media materials, but also are regarded as a social outlet [23] and an educational tool [24,25], and they have become so widespread and popular in recent years that almost all college or university students possess this device [26]. The contribution of mobile phones to learning outcomes, independent learning [27], foreign language learning [28], and provision of instant feedback in real-time [29], among other things, is well-established in the literature.

However, having said this, mobile phones have become an indispensable part of the experience for every youngster, and some devices dramatically impair a young person's memory and concentration. There is a wide variety of contrary opinions about this phenomenon, which is widely reported in the literature [30]. Despite these appeals, the use of mobile phones for educational purposes has become a controversial issue among educational researchers and practitioners in related areas. Many researchers have raised serious questions associated with the effects of mobile phones on academic performance, achievements, and behavior of students [31–33]. Moreover, students use their mobile phones for a variety of reasons, for example, to record audio/video of the lectures, to send/receive text messages, to make/receive calls, to access the internet for searching information, and to use different applications such as reminders, calculators, educational apps, timers, and security and safety issues, especially in case of emergency. So, students may use their mobile phones during the lecture hours either for the reasons mentioned above or for the addictive effect of these devices. There are underlying causes related to the administration of mobile phones, which are to be elaborated on, and some of them have had a significant effect on every aspect of principal human responsibilities; mobile phones have had a diverse influence on some aspects of individual functions.

Although numerous studies and investigations about the alternative utilization of mobile phones on people's lives, educational settings, industrial and commercial advancements, and educational applications of learning foreign languages have been widely reported in the literature, there has been increased attention focused on the subject of why students persistently use mobile phones during lecture hours even when their usage is forbidden. In this comparative study, which accounted for the use of mobile phones during lecture hours and its benefits and drawbacks concerning this issue, there will be a concentration on the significant parameters that severely affected the students' situation. To do this, a quantitative computer-based analysis was used to consider each influential parameter on the students' tendency toward mobile phone utilization during lecture hours. Furthermore, there are few studies, little research, and only a non-comprehensive evaluation to grasp the importance of using

mobile phones during lecture hours, and the reason why students use mobile phones in the classroom and how this behavior contributes to or impedes their learning is of great importance.

## 2. Literature Review

The use of mobile phones among university students has dramatically increased due to the high accessibility of this device and the quality of processing information in the shortest time, just like computers. In this respect, the mobile phone is considered as one of the primary multimedia devices in research, having educational purposes such as leading seminars and classroom presentations instead of using laptops, and with benefits like low space occupation, pocket-size, flexibility, and ubiquity. Hence, the popularity of mobile devices among lecturers and university academics because of their affordability and ubiquity leads us to question the balance between individual requirements and recent innovation technologies. Furthermore, the pervasive force of mobile phones during lecture hours provides students with a strict sense of purpose to present their principles more confidently, and subsequently, they feel a strange sense of calm after their presentation. For example, during lecture hours, they handled their tasks without any anxiety and stress of forgetting necessary information [34–36].

Collaborative, contextual, constructionist, and constructivist learning environments offered by mobile phones are referred to as mobile learning [37,38]. Indeed, the advent of technology and mobile devices, specifically the mobile phone, and their widespread use by different people such as students has changed the roles for both teachers and students because the application of these devices has changed the nature of learning activities compared to the traditional activities. In comparison to the traditional ‘top-down’ teaching methodologies, which assume that teachers are authorities who are responsible for delivering the academic content to the students, in the ‘bottom-up’ teaching approach, teachers function as a mediator or even co-learners to facilitate learning and knowledge acquisition by the learners [30,39], and to guide them throughout the learning process. This has caused classrooms to become increasingly student-centered and to rely on peer collaboration and independent learning [40]. Therefore, it has been assumed that mobile devices have the potential to satisfy students’ educational needs. However, this assumption has raised more serious questions addressed by the researchers, such as in the following issues;

- ✓ Can mobile phones be utilized as an educational device for teaching and learning?
- ✓ To what extent are mobile phones accepted as educational devices?
- ✓ What are students’ attitudes about using mobile phones as educational devices?
- ✓ What should be done to make the best of mobile phones as educational devices?
- ✓ What are the effects of mobile phones on the academic performance of students?

In an attempt to answer these questions, the researchers have identified several advantages and disadvantages of mobile phone use by students, as presented in the following.

### 2.1. Benefits of Utilizing Mobile Phones in the Classrooms

A mobile phone is not just a device for making phone calls anymore. Recent technological advancements have vividly promoted the frequency and types of mobile phone-enhanced activities including searching and finding information from different websites, connecting and subscribing to diverse social networks, sharing multi-media materials and pictures, etc. [41]. In simple words, mobile phones have provided comprehensive learning experiences, portability, convenience, multi-sources and multitasks, easy access to information at any time and any place, and environmental friendliness [36]. The most frequently reported advantage of mobile phone use is the Internet accessibility. In a survey of approximately 1100 teachers, Thomas, O’Bannon [42] found that student’s access to the Internet was the most important advantage of using mobile phones in classrooms [12,43]. Moreover, ICT in general and the mobile phone, in particular, have proven to be conducive to student’s learning, engagement, motivation, and productivity [42].

It has been argued that student engagement in learning tasks will result in deep understanding. According to Purcell and Heaps [44], most teachers reported that the students used mobile phones to complete research through the Internet. The students appeared to use their mobile phones to access assignments online, to complete assignments, and submit assignments online by 73%, 79%, and 76%, respectively; for example, mobile phones provide access to online tools such as Dropbox and Web 2.0 tools, and mobile apps in the classroom. Students also prefer texting (the most frequently-used function of mobile phones) for communication and collaboration with teachers, colleagues, and content via sending/receiving text messages. For example, Thomas, O'Bannon [42] investigated the effect of teacher-generated text messages on different course-related subjects by surveying high school students. According to the results, the students perceived that the utilization of this intervention contributed to both student-teacher and student-content interaction. Texting has also helped improve students' phonological awareness, vocabulary, and reading ability [45]. Video and/or audio recording is one of the most functional characteristics of mobile phones which contribute to learning. For instance, it has been found that student-generated podcasts can improve their language skills, including, writing, reading, and listening [46]. Thereby, teachers can also benefit from podcasts or videocasts, which are appealing to learners.

## 2.2. Barriers to Utilizing Mobile Phones in the Classrooms

Despite the numerous advantages of mobile phones, there are numerous major stumbling blocks attributed to them which need to be considered. In general, prior research studies have illustrated that students continue to use mobile phones in classrooms during lecture hours even when their use is forbidden [47,48]. Disruption is the first problem associated with the use of mobile phones in the classroom [31,49,50]. In Baker and Lusk's [32] study, university students perceived the use of mobile phones as disruptive, individually when checking and sending text messages, making calls, and checking their emails. Moreover, performing different tasks simultaneously may result in interference. For instance, when a student is supposed to be listening to a lecture and simultaneously sends a text message, his performance is likely to be impaired [51]. On the other hand, some researchers argue that, if two or more tasks involved are not related, for example, taking notes of a lecture and looking for a friend's picture, they may not cause interference or any adverse effect on a student's performance. Regarding this issue, few studies have addressed the effect of mobile phone multitasking (i.e., performing more than a single activity at a time [51]) on learning the outcome.

In Bowman and Levine's [52] study, instant messaging during reading comprehension caused the disruption, wasting time during the study, and increased re-reading. Harman and Sato [53] surveyed the frequency of texting in the classroom as reported by 118 undergraduate students, and its relationship with their GPA. The findings of this study indicated that the high frequency of receiving and sending messages significantly reduced the students' GPAs. Kuznekoff and Titsworth [54] addressed three aspects of distraction, including the recall of knowledge, note-taking, and lecture listening. They compared three groups of students: A low-distraction group with 12 messages or posts being sent to them, a high-distraction group with 24 posts or messages being sent to them during a video lecture, and a control group with no distraction involved. The researchers went on to argue that, in comparison with the two distraction groups, students in the control group scored the highest and recalled more than 62% of the information presented to them [50,55]. Another concerning issue is related to the abbreviations and slangs used for texting in digital environments which creep into students' formal academic writing. However, the findings of these studies are mixed. For instance, whereas Coe and Oakhill [56] reported a positive relationship between texting and literacy, Drouin and Driver [57] found a negative relationship between them.

Social networking websites such as Twitter and Facebook are also pervasive among the university students, and given their popularity, have been the subject of some studies [58,59]. To clarify the importance of this issue, Abdulahi and Samadi [60] argued that social network sites have now become an addiction for many of them. However, some studies have shown that social media can contribute

to education [61]. Laura and Bradley's [62] investigations expressed that some Malaysian students reported more instant messaging activities and media usage, and were engaged in more electronic and non-electronic activities for non-academic purposes and entertainment, whereas the American students used multitasking while learning to maintain social communication.

### 3. Objectives of the Study

Regarding the investigations of this study compared with those in the previous reviewed section, it is highlighted that the students extensively use mobile phones in classrooms. However, the previous studies had contradictory findings and identified both advantages and disadvantages attributed to the use of mobile phones, while principal factors such as age and gender, which might have a profound impact on students' use of mobile devices in the classroom, were under-investigated. Moreover, to the best of the authors' knowledge, it was found that this topic has not been addressed in the context of university purposes. Therefore, the present study was designed to answer the following three research questions:

1. Why do undergraduate female and male students use mobile phones during lecture hours?
2. Why do undergraduate students from different age groups use mobile phones during lecture hours?
3. Why do undergraduate students from different grades use mobile phones during lecture hours?

### 4. Methodology

#### 4.1. Context and Preparation of the Study

This study was conducted in one of the Cyprus universities. The present study had a quantitative research design using a survey which yielded a collection of quantitative data to be analyzed by statistical techniques. Indeed, the survey is "questioning individuals on a topic or topics and then describing their responses" [63]. In light of the indices above and to be able to engage more participants, convenience sampling was utilized to select the participants. The questionnaire (as it is provided as Table S1 in supplementary materials) was distributed among the participants, who agreed on the selection criteria, and received a brief explanation of the topic of the survey, as well as instruction on how the questionnaire should be filled.

#### 4.2. Participants

The investigated statistical population of the current study was approximately 5000 undergraduate students in one of the Cyprus universities in 2019 in which, using the Cochran formula to calculate sample size from the studied population, only 330 persons would be sufficient to provide a consistent output. However, due to the enhancement of sensitivity analysis and to be more verified from the provided sampling, we assume 520 students as the investigated sample via simplified random methodology. The approximately overwhelming majority of the participants are between the ages of 18–26. However, there were a few participants that were out of this age range which would be negligible as there were outlier inputs. Therefore, we neglected the outlier data from the analysis by considering the age range between 18–26 and homogenized the age range to three principle homogeneous categories of 18–20, 21–23, and 24–26. The participants were selected from one of the Cyprus universities due to the high number of undergraduate students studying at university. The eligibility criteria for participation in this study were (1) owning a mobile phone, (2) acknowledging the use of his/her mobile phone during lecture hours, and (3) studying in one of the Cyprus universities for the duration of this research. Table 1 shows the demographic information of the participants.



**Table 1.** Demographic features of the participants.

Students	Category	Frequency	Percentage
Gender	Male	236	57.3%
	Female	284	42.7%
	<b>Total</b>	<b>520</b>	<b>100</b>
Age	18–20	168	32.3%
	21–23	136	26.15%
	24–26	216	41.55%
	<b>Total</b>	<b>520</b>	<b>100</b>
Grade	1	152	29.23%
	2	136	26.15%
	3	120	23.09%
	4+	112	21.53%
	<b>Total</b>	<b>520</b>	<b>100</b>

Table 1 provides information about the undergraduate students in one of the Cyprus universities, categorized into three subsections of gender, age, and grade of the participants. As can be seen in Table 1, the sample included 57.3% (N = 236) male and 42.7% (N = 284) female students. 32.3% (N = 168) of the participants were between 18 and 20 years old, 26.15% (N = 136) were between 21 and 22 years old, and 41.55% (N = 216) were 23 and above. Concerning their grades, 29.23% (N = 152) of the participants were freshmen, 26.15% (N = 136) were sophomore, 23.09% (N = 120) were junior, and 21.53% (N = 112) were senior students.

#### 4.3. Instrument

The questionnaire used in this study to collect data was adopted from Olufadi (2015), consisted of 38 questions, and was in paper format. This questionnaire has two distinct parts. The first part of the student questionnaire involves seven questions which aim to elicit the demographic information of the participants, including gender, age, and grade. The second part of the questionnaire has 38 questions broken down into six sections which inquire about mobile phone use during lecture hours and focusing on six reasons. The major reasons are; class-related use (e.g., to receive or make calls or send/receive text messages), social connection (e.g., to chat with friends or family, and to be in touch with family), boredom (e.g., students using phones during class when the class is dull), emergency (e.g., students' need to make an important call to his/her relatives or family), addiction (e.g., controlling the temptation to connect to social networking sites like Facebook by the students), and perceived behavioral control (e.g., the capability of a student to use a mobile phone while simultaneously paying attention to the lecture in the classroom). The questionnaire is scored on a five-point Likert-scale from never (1) to always (5).

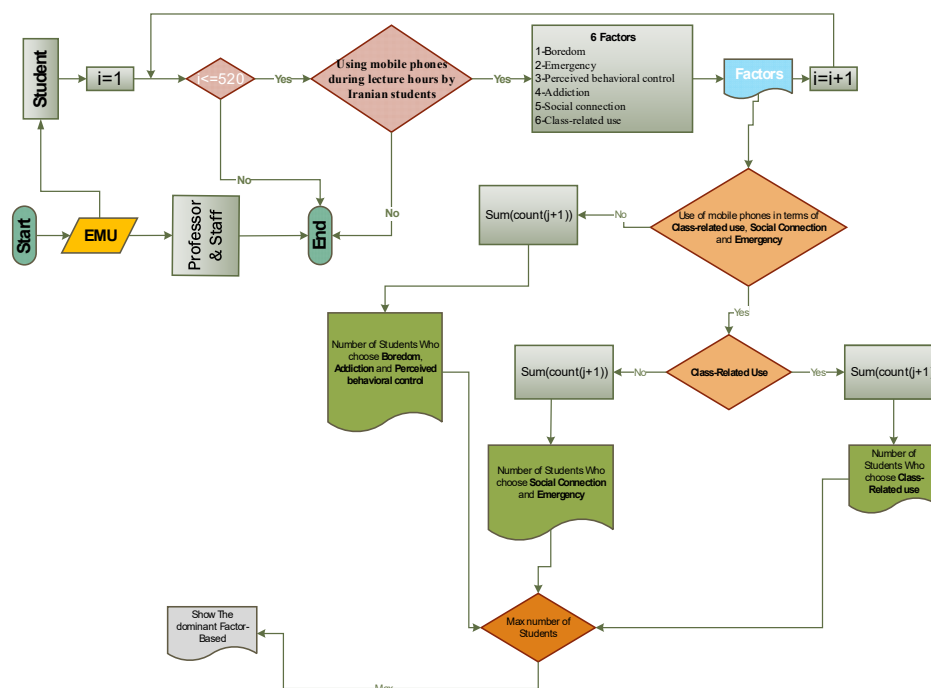
#### 4.4. Data Collection and Data Analysis Procedures

The study was conducted in the 2019 academic year in the Fall semester in one of the Cyprus universities. After obtaining the university administrators' and coordinators' agreement, a total of 520 student participants volunteered to participate in the study. After providing a brief explanation of the goals of the study and giving instruction on how to complete the questionnaire, the students completed the questionnaires in approximately fifteen minutes. The researcher gave students sufficient time to read the questionnaire carefully without any intervention that would affect their responses. A total of 520 questionnaires were collected over three weeks. We aimed to measure the mean items from the category of proposed questions through the questionnaire to generate each category's latent variable by SPSS software. To proceed with the data normalization throughout the procedure, we calculate the kurtosis and asymmetry values for each factor. As the kurtosis and asymmetry values for each factor were from  $-2$  to  $2$ ; thereby, the proposed data in this paper was followed by a normal distribution [64].

To analyze the quantitative data obtained from the questionnaires, the data was inserted into the Statistical Package for Social Sciences (SPSS), descriptive statistics were performed, and the frequencies and percentages of the six reasons for the use of mobile phones during the lecture hours were computed. To compare the differences between the male and female students, six Independent Samples *t*-tests were performed, and to compare the differences concerning age and grade differences, two ANOVA tests were performed, then post-hoc test, which is followed by the variance analysis to distinguish the considerable statistical differentiation of each group among other groups by testing all the pairing group possibilities [65,66]. After the descriptive data normalization of the samples, Spearman's nonparametric Rho correlation was utilized to analyze the interest variables relationship where the results have statistically presented in appropriate tables for analysis and discussion purposes.

#### 4.5. Evaluation Procedure

In this part of the study, we provide a brief schematic highlight of the evaluation procedure according to the six principal factors which are based on the Eastern Mediterranean University (EMU) participants to evaluate the importance of each factor. This phenomenon is schematically illustrated in Figure 1. As shown in Figure 1, the group of participants answered a comprehensive evaluation questionnaire regarding six crucial factors about their use of mobile phones during lecture hours. Results showed that class-related use was considered as the most important factor by the students. After that, emergency and social connection were on the second stage, according to the student's responses. Furthermore, students demonstrated that extra uses of mobile phones during lecture hours might have a possible negative impact on every aspect of classroom assignment and meaningful learning. These factors entail boredom, addiction, and perceived behavioral control which should be considered as debatable phenomena. Therefore, a significant and holistic solution should be taken into consideration to reduce the use of mobile phones during lecture hours and subsequently enhance the quality of mobile phones' utilization in other circumstances to avoid unnecessary distractions and confusion in the classroom, which possibly reduces the student's concentration.



**Figure 1.** Schematic illustration of evaluation procedure. It should be noted that (i) is the number of students who participated in the questionnaire, and j is the principal factors as contributed by the students. Furthermore, in this flowchart, factors are being categorized as the three sections as can be seen in the flowchart. A class-related use is considered as a significant factor.



#### 4.6. Reliability Coefficients for the Consideration of Principal Factors

To ensure the reliability of the proposed factors, which is based on the results of this investigation, Cronbach's alpha was initially calculated for each considered factor. According to the result of the Cronbach's alpha by SPSS software, it is evident that the proposed factors have an appropriate consistency adaptation with the provided questions. Due to the calculated variables of 0.7 and higher, which significantly declared that the reliability of these factors is in proper form owing to Cronbach's alpha. The instrument has been shown to meet adjustment reliability, which is why it is considered to have excellent reliability. Reliability coefficients for the considered factors and normality test is statistically depicted in Table 2.

**Table 2.** Reliability coefficients for the considered factors and normality test.

Factor	N of Items	Cronbach's Alpha	Asymmetry	Kurtosis
Boredom	7	0.774	0.077	0.370
Social connection	6	0.772	0.235	−0.219
Class-related use	9	0.813	−0.208	−0.351
Emergency	6	0.860	0.202	−0.462
Addiction	6	0.790	0.185	−0.451
Perceived behavioral control	4	0.701	0.378	0.137

To verify the validation of the proposed items in the questionnaire, six experienced members in the field of information and communication research systems, e.g., the utilization of mobile phones on student's behaviors, scale development, and such conceptual-perception psychology phenomena were contributed to analyze the questionnaire regarding Lynn's recommendation (1986). To validate the measurement scales, qualitative and quantitative content validity were taken into consideration as follow.

1. Qualitative content validity; due to the researchers' request from the specialist in this field, they proposed to qualitatively consider the measurement scales in accordance to the grammar typos, wording, item allocation, and scaling issues, and give their feedback to modify the following items. Quantitative content validity; in this part, two validity indexes such as content validity ratio (CVR) and content validity index (CVI) were taken into consideration.
2. To identify CVR, the three essential items of "essential", "useful but not essential", and "not necessary" were requested from the specialist panel to distinguish each item clearly. Then, responses were calculated by Lawshe [67,68] formula as follows (1975);

$$CVR = \frac{n_E - \frac{N}{2}}{\frac{N}{2}} \quad (1)$$

where  $n_E$  is the number of specialists that responded "essential", and  $N$  is the total number of specialists that have participated. The value of calculated CVR for each question (item) was considered from the corresponding value from the Lawshe table. However, if the calculated CVR from the mentioned formula is more significant than its corresponding value from the Lawshe table, the content validity of the proposed question was verified. Elsewhere, the question would be removed. Therefore, the content validity ratio of the questions in the questionnaire was being verified.

To determine CVI, three fundamental criteria such as simplicity, relevancy, and clarity were separately taken into consideration in a four range Likert scale (e.g., not relevant, roughly relevant, relevant, and very relevant) [68]. Besides, some additional spaces were placed in the evaluation form for the reviewers to put their additional comments on the questionnaire, which might be useful on the improvement of the proposed questionnaire in further processing. Thereby, to analyze each

individual's item validity, content validity index (CVI) was taken into consideration by the reviewers. Regarding the findings of Lynn [67], if there are three or four CVI ratings, it is the evidence of consistent and valid content according to the proposed conceptual framework.

Regarding the utilization of this criterion, none of those mentioned above, 38 items are neglected due to the score of CVI, which is 1.00. For instance, if four of the six provided reviewers responded as the relevant items, the CVI would be of 0.67. As this score would not provide the required endorsement level (CVI = 0.83) to meet the content validity index for the specialist panel in the significant level (it is 0.5), it has been concluded that the following item should be neglected [67].

#### 4.7. Correlations

The analysis of the correlation matrix, which is based on the six administered variables in this study, has been conducted in the statistic correlation level of 0.01, which is ranged from 0.043 to 0.601. In Table 3, there is a 6 \* 6 matrix which indicated the six different studied variables. Moreover, a combination of each pair of these variables was conducted, and their correlation coefficients were calculated for each pair according to the Pearson correlation. Due to the obtained correlation coefficient from the matrix correlation table, it is evident that with 0.99 of confidence level and error level less than 0.01 between the boredom and social connection ( $r = 0.601, p < 0.01$ ). Hence, there is a relatively strong correlation between the variables, and it has the highest possible correlation in comparison among other variables. Besides, the positive value for this parameter has indicated that the alteration of these two parameters is in the same direction. Subsequently, owing to the boredom during the class sessions, students tended to use their mobile phones more, which means they are entertained more in social networking applications. Afterwards, the second-highest correlation coefficient is between social connection and addiction ( $r = 0.600, p < 0.01$ ). Hence, the use of social networking applications among students would be considered as the addiction increase rate to these applications and has caused lower grades in their lessons. On the other hand, regarding the correlation coefficients between boredom and class-related use ( $r = 0.146, p < 0.01$ ), addiction and class-related use ( $r = 0.051, p < 0.01$ ), class-related use and perceived behavioral control ( $r = 0.043, p < 0.01$ ), and emergency and perceived behavioral control ( $r = 0.0163, p < 0.01$ ) indicated that there is no correlation between these variables. Thereby, each of the following pairs has no linear correlation together.

**Table 3.** Descriptive statistics and correlations of latent variables.

Construct	Construct					
	1	2	3	4	5	6
1. Boredom	1					
2. Social connection	0.601 **	1				
3. Class-related use	0.146	0.266 **	1			
4. Emergency	0.310 **	0.507 **	0.464 **	1		
5. Addiction	0.490 **	0.600 **	0.051	0.374 **	1	
6. Perceived behavioral control	0.419 **	0.467 **	0.043	0.163	0.469 **	1

N = 520. Significance Level  $p < 0.01$  \*\*.

## 5. Results

This section presents the results in appropriate tables and discusses the findings of the study. More specifically, the reasons why students are inclined to use their mobile phones during lecture hours are discussed statistically. According to the findings of this study, gender, age, and grade of the students have a significant effect on their mobile phone usage during lecture periods based on six reasons (i.e., Boredom, social connection issue, class-related use, emergency issue, addiction issue, and perceived behavioral control). The limitations of each questionnaire have contained the participants specified time, dishonest answers, unanswered questions, differences in understanding, interpretation for each participant,

difficulties in the interpretation of participant's analysis, lack of personalization, and unconscientious responses might have affected the results of this quantitative computer-based analysis.

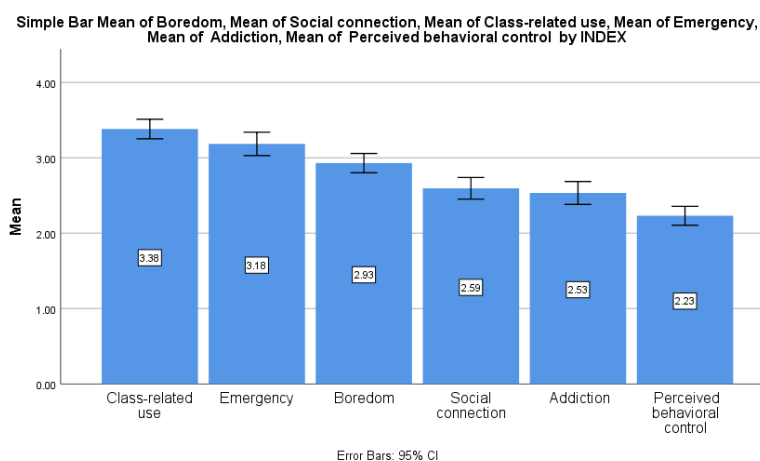
As it is clarified in Table 4, class-related use has the maximum response among participants. According to the category "High" as indicated by the selected students, it is evident that about 40 percent of students said that class-related use was the most crucial factor, rather than other factors, and it allocated about 2/5 of the students' statements. For one thing, students mainly used their mobile phones to take photographs of material written on the board as one of the easiest and fastest ways of fostering the new knowledge compared to writing. Furthermore, the second-highest proportion of this comprehensive study has been allocated to the emergency category; it shows that 1/3 of the students reported that they had to use their mobile phones to send an urgent message or make an urgent call. As is evident from Table 3, the least reported use of the mobile phone was associated with perceived behavioral control, which is approximately 1/13 of the maximum factor of class-related use. Regarding this, it is characterized simultaneously by using their mobile phones and paying attention to the lecturers, which usually results in distraction.

**Table 4.** Perceptions of students on the use of mobile phones during lecture hours.

Factors	1- Low *		2- Middle		3- High	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Boredom	96	18.5	336	64.6	88	16.9
Social connection	176	33.8	284	54.6	60	11.5
Class-related use	32	6.2	284	54.6	204	39.2
Emergency	64	12.3	288	55.4	168	32.3
Addiction	200	38.5	264	50.8	56	10.8
Perceived behavioral control	316	60.8	192	36.9	12	2.3

\* To ensure the efficiency and accuracy of the investigated procedure, it has been divided into a three-stage range of frequencies; low (1–2.33), middle (2.34–3.66), and high (3.67–5), respectively. By doing this, the interpretation of data leads to the conversion of scale status to the ordinal status, which is being accepted by the SPSS programming to compare the high level of these factors.

According to the analytical evaluations from Figure 2, which is derived from SPSS software to compare the significant influence of six principal factors which are being addressed in this investigation to the student's tendency for using mobile phones during lecture hours, it can be seen that class-related use factor has specified the maximum average number of students who have indicated this phenomenon as their priority of using mobile phones during lecture hours. It is approximately 3.5 of the mean factor, which is relatively 1.5 times of the minimum number of student's tendency to using mobile phones which is related to perceived behavioral control. Since then, students proposed that the emergency and boredom factors are the second largest percentage of the mean factor in response to the use of mobile phones during lecture hours; in this respect, both of these factors experienced an approximate pattern mean factor of 3.



**Figure 2.** The analytical mean factor which is derived from SPSS 23 software for the principal factors of student's tendency in using mobile phones during lecture hours.

### 5.1. Comparison of Gender-Based Inequality (T-Test)

The first research question sought to see whether there is a difference between male and female students' use of mobile phones during lecture hours. To achieve this purpose, an Independent Samples *t*-test was run to compare the results concerning the six reasons for mobile phone use in the questionnaire, as it is shown clearly in Table 5.

**Table 5.** Results of *t*-test for identifying gender differences in mobile phone use.

Variables Dimensions	Gender	Group Statistics			<i>t</i> -test Sig.
		N	Mean	SD	
Boredom	Male	236	2.97	0.69	0.512
	Female	284	2.89	0.77	
Social connection	Male	236	2.66	0.83	0.387
	Female	284	2.53	0.82	
Class-related use	Male	236	3.30	0.74	0.290
	Female	284	3.44	0.74	
Emergency	Male	236	3.24	0.94	0.459
	Female	284	3.13	0.85	
Addiction	Male	236	2.46	0.86	0.430
	Female	284	2.58	0.88	
Perceived behavioral control	Male	236	2.23	0.66	0.974
	Female	284	2.22	0.76	

\*  $p < 0.05$ .

As it is evident in Table 4, four of the six categories are male-dominated in mean scores; boredom (2.97 vs. 2.89), social connection (2.66 vs. 2.53), emergency (3.24 vs. 3.13), and perceived behavioral control (2.23 vs. 2.22). On the other hand, females' mean scores only were higher than males' in addiction (2.58 vs. 2.46) and class-related use (3.44 vs. 3.30). However, the results of the *T*-tests show that gender differences based on the six reasons for the use of mobile phones are not significant ( $p > 0.05$ ).

### 5.2. Comparison of Age-Based (ANOVA)

The second part of the research evaluation entailed a comparative difference in using mobile phones during lecture hours among the students at divergent age groups. To investigate this, the students were classified into three homogenous age groups: 18–20, 21–23, and 24–26. Analysis of Variances (henceforth, ANOVA) for six principal factors was performed to identify the differences between these three groups, to demonstrate the results statistically in Table 6.

As it is evident in Table 6, the overwhelming majority of the students in the age range of 18–20 indicated that the three principal factors of boredom, social connection, and perceived behavioral control played a progressive role in the use of mobile phones during lecture hours. Whereas the second group of students in the age range of 23 or above stated that emergency and class-related use of mobile phones is considered as the primary reason for using mobile phones during lecture hours. On the contrary, only on one occasion, in the addiction category, did students in the age of 21–22 propose that they would be concerned with addiction as the principal function. Moreover, the age differences were not significant concerning any of the reasons for mobile phone use ( $p > 0.05$ ).

### 5.3. Comparison of Grade-Based (ANOVA)

The third section of this analysis was related to the addressing of the differences in using mobile phones during lecture hours among the students in different grades. Grades are divided into four parts: First-year (freshman), second-year (sophomore), third-year (junior), and fourth-year (senior). Then, six ANOVA was run to identify the differences between these four different categories, and their comparison is illustrated clearly in Table 7.

**Table 6.** Results of ANOVA for identifying age differences in mobile phone use.

Variables	Group Statistics ANOVA				Sig.
	Ages	N	Mean	SD	
Boredom	18–20	188	2.91	0.81	0.629
	21–23	116	3.04	0.79	
	24–26	216	2.88	0.64	
	<b>Total</b>	<b>520</b>	<b>2.93</b>	<b>0.74</b>	
Social connection	18–20	188	2.73	0.90	0.197
	21–22	116	2.65	0.81	
	24–26	216	2.44	0.75	
	<b>Total</b>	<b>520</b>	<b>2.59</b>	<b>0.83</b>	
Class-related use	18–20	188	3.27	0.77	0.063
	21–23	116	3.22	0.78	
	24–26	216	3.56	0.69	
	<b>Total</b>	<b>520</b>	<b>3.38</b>	<b>0.75</b>	
Emergency	18–20	188	3.13	0.92	0.803
	21–22	166	3.15	0.88	
	24–26	216	3.25	0.90	
	<b>Total</b>	<b>520</b>	<b>3.18</b>	<b>0.90</b>	
Addiction	18–20	188	2.64	0.96	0.509
	21–23	166	2.55	0.90	
	24–26	216	2.43	0.79	
	<b>Total</b>	<b>520</b>	<b>2.53</b>	<b>0.88</b>	
Perceived behavioral control	18–20	188	2.32	0.70	0.538
	21–23	166	2.19	0.79	
	24–26	216	2.17	0.71	
	<b>Total</b>	<b>520</b>	<b>2.23</b>	<b>0.72</b>	

**Table 7.** Students' perceptions of mobile phone usage during lecture hours according to grade.

Dimensions	Years of Study	N	Mean	SD	Sig.
Boredom	1	152	2.72	0.81	0.087
	2	136	3.16	0.64	
	3	120	2.89	0.82	
	4	112	2.98	0.59	
	<b>Total</b>	<b>520</b>	<b>2.93</b>	<b>0.74</b>	
Social connection	1	152	2.47	0.92	0.307
	2	136	2.74	0.77	
	3	120	2.73	0.87	
	4	112	2.44	0.70	
	<b>Total</b>	<b>520</b>	<b>2.59</b>	<b>0.83</b>	
Class-related use	1	152	3.36	0.82	0.925
	2	136	3.41	0.75	
	3	120	3.44	0.77	
	4	112	3.32	0.65	
	<b>Total</b>	<b>520</b>	<b>3.38</b>	<b>0.75</b>	
Emergency	1	152	3.12	0.93	0.414
	2	136	3.11	0.86	
	3	120	3.43	0.94	
	4	112	3.10	0.85	
	<b>Total</b>	<b>520</b>	<b>3.18</b>	<b>0.90</b>	
Addiction	1	152	2.14	0.72	0.001 *
	2	136	2.85	0.89	
	3	120	2.82	0.90	
	4	112	2.37	0.80	
	<b>Total</b>	<b>520</b>	<b>2.53</b>	<b>0.88</b>	
Perceived behavioral control	1	152	2.05	0.63	0.217
	2	136	2.40	0.82	
	3	120	2.23	0.73	
	4	112	2.29	0.68	
	<b>Total</b>	<b>520</b>	<b>2.23</b>	<b>0.72</b>	

(1: Freshman students, 2: Sophomore students, 3: Junior students, 4: Senior students) \*  $p < 0.05$ .

In this part of the study, we decided to classify each grade and investigate each variable on each grade. To do this, as is evident in Table 6, freshman and junior students had the same pattern in expressing their ideas; in respect of the way class-related use and emergency factors allocate the maximum percentage use of mobile phones themselves. The class-related use is about 3.36 and 3.12, and the emergency factor is relatively 3.41 and 3.43, respectively. Besides, the perceived behavioral control classification was the minimum percentage of a mean factor among freshman student at 2.05 percent; it was reported as about 2.23 for junior students. Next, sophomore and senior students had a similar trend in providing their response. They believed that class-related use factor comprised the largest proportion among other factors (3.44 and 3.32, respectively) and perceived behavioral control factor was the least percent (2.23 and 2.29, respectively). In other words, as it is clear in Table 6, the differences in the mobile phone use by the students in the four grades were not statistically significant concerning all the reasons ( $p > 0.05$ ). This is with the exception of addiction ( $p = 0.001$ ) by using second and third-year students using their mobile phones in a more addictive manner ( $M = 2.85$  &  $2.82$ , respectively) than the first and fourth-year students ( $M = 2.14$  &  $2.37$ , respectively). Therefore, the results of this paper in the grade-based analysis demonstrated that perceived behavioral control in all the four categories had the minimum percentages, to diminish the importance of this factor by all the students. All the students mention Class-related use factor as one of the greatest appeal factors of using mobile phones during lecture hours. Afterwards, the variance analysis was done by the least significant difference (henceforth; LSD) post-hoc comparative method to nurture the profound differences between the existed group levels.

As it is evident in Table 8, the mean pairwise comparison was conducted for the addiction variable among four different age ranges. The significant value from Table 8 was calculated by the assumption of a confidence level of 95% and the error level of 5%. According to the obtained results from this Table, there are no significant differences on the first-year group and fourth-year group ( $\text{Sig} = 0.689$ ), second-year group and third-year group ( $\text{Sig} = 0.999$ ), and the third-year group and fourth-year group ( $\text{Sig} = 0.164$ ). Otherwise, there is a significant difference between the first-year group and the second ( $\text{Sig} = 0.002$ ) and third ( $\text{Sig} = 0.006$ ) year group. Moreover, regarding the obtained negative value of mean difference from the mean value between group one and two ( $-0.712$ ), and the mean value between group one and three ( $-0.681$ ) indicated that group one had less mean value rather than group two and three. Thereby, the first-year students had experienced less mobile use addiction during lecture hours rather than second- and third-year students. Besides, the highest mobile use of addiction is related to second-year students.

**Table 8.** The analysis of LSD post-hoc method (dependent variable is an addiction).

(I) Years of Study	(J) Years of Study	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	2	<b>-0.71259 *</b>	<b>0.19579</b>	0.002	-1.2223	-0.2028
	3	<b>-0.68187 *</b>	0.20256	0.006	-1.2093	-0.1545
	4 and higher	0.22751	0.20656	0.689	-0.7653	0.3103
2	1	0.71259 *	0.19579	0.002	0.2028	1.2223
	3	0.03072	0.20775	0.999	-0.5102	0.5716
	4 and higher	0.48508	0.21165	0.105	-0.0660	1.0362
3	1	0.68187 *	0.20256	0.006	0.1545	1.2093
	2	-0.03072	0.20775	0.999	-0.5716	0.5102
	4 and higher	0.45437	0.21793	0.164	-0.1131	1.0218
4 and higher	1	0.22751	0.20656	0.689	-0.3103	0.7653
	2	-0.48508	0.21165	0.105	-1.0362	0.0660
	3	-0.45437	0.21793	0.164	-1.0218	0.1131

\* The mean difference is significant at the 0.05 level.

In this part of the study, by the utilization of homogenous subsets test, those groups that had close mean values were put in one section in which the mean value was presented ascendingly. Therefore, according to the results of Table 9, it was shown that regarding the mean comparison and

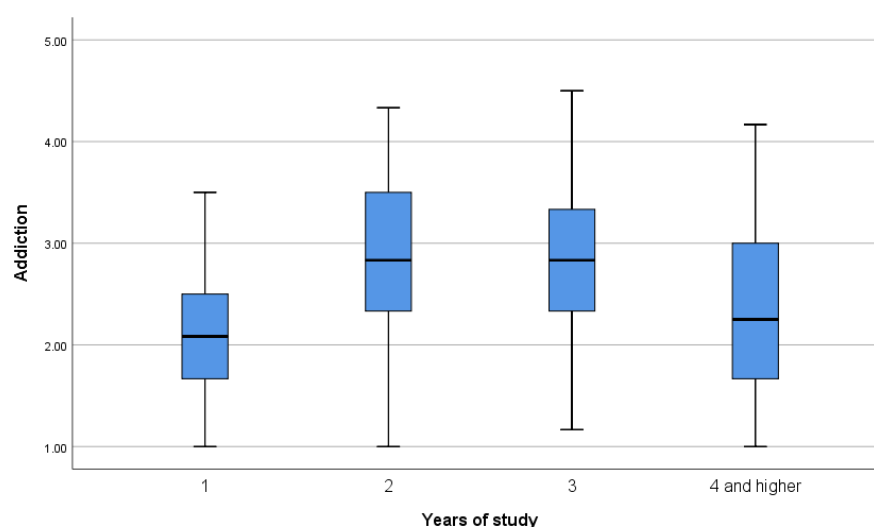


their sequences, the first-year group had the least addiction mean value of 2.14, and the second-year group had the maximum addiction mean value of 2.85. On the other hand, in the second report of Table 9, the profound meaningful concept of the addiction mean value should be generated as the homogenous groups. In this table, each homogenous group has consisted of one column in which two homogenous groups were created. The first homogenous group has consisted of the first- and fourth-year groups. Additionally, the second homogenous group was included in the second- and third-year group. The creation of these groups indicated that first- and fourth-year groups had no difference in addiction mean value. However, there is an essential difference between this group with second- and third-year group. Hence, two different groups regarding the addiction mean value were generated. As can be seen in Table 9, to distinguish the primary placement of fourth-year group in the homogenous section, as it had a similar variance in both subsets, we assume fourth-year group students in both subsets of the mean value calculations. Therefore, due to the negligible impact of the fourth group in the analysis process, we assume the other three groups as the pairwise comparison to determine the existence or non-existence of significant correlations.

**Table 9.** The analysis of the homogeneous subsets method (dependent variable is addiction and subset for alpha is 0.05).

Years of Study	N	1	2
1	38	2.1404	-
4 and higher	28	2.3679	2.3679
3	30	-	2.8222
2	34	-	2.8529
Sig.	-	0.691	0.094

As can be seen in Figure 3, the maximum addiction mean value was related to the second-year students, and the minimum mean value was recorded for first-year students. Otherwise, the mean value for first- and fourth-year students are approximately the same; so, there was no meaningful comparison in the multiple comparison table, as the significant factor for these two variables was recorded as 0.689. Although, the first year and second year groups were put in the same level (Sig = 0.002), the first year and third year groups were put in the two different levels from each other (Sig = 0.006). Therefore, the mobile use addiction rate in first-year students is differentiated from second- and third-year students; that is to say that there was no significant difference in mobile use addiction between second- and third-year students (Sig = 0.999).



**Figure 3.** Addiction means value comparison among the four-year student groups.

## 6. Discussion

The findings of the present study indicated that the students utilized mobile phones, especially for texting and chatting with their family or friends, and sharing files via social networks. The use of mobile phones for reading news or even gaming was rare. Similar to many classrooms across the world, a maximum number of students in this study used their mobile phones for class-related purposes, for example, supporting information or accessing teaching materials such as lecture notes or slides for taking notes, searching information about classwork, and utilizing some applications (i.e., calculator). Furthermore, they appeared to use their phones usually when they felt bored in the class because they find the lesson boring; in fact, students are more involved when classes are interactive and encourage interaction with teachers and peers. There is a likelihood of getting addicted to mobile phones because they have become a constant companion, and many students are addicted to texting or lack self-control concerning the connection to social networks like Facebook and Twitter. However, sometimes students need to do something urgent during classroom hours with their friends or family. For example, they need to make/receive an urgent call or get someone to do something for them, which makes this purpose one of the most frequently reported reasons for the mobile phone use during the lecture hours. The results also indicated that there was not a significant difference between male and female students in the use of mobile phones. In other words, both genders demonstrated an equal tendency to use mobile phones for different purposes. This finding is consistent with those found by Economides and Grousopoulou [69] who compared perceptions of Greek female and male students in the use of mobile phones. Likewise, there were no statistically significant differences among the students within different age groups. It demonstrates that age is not a determining factor in the desire for using new technologies during the lecture hours.

However, this finding is in contradiction with the results found by Ukueze [70]; grade differences were significant only as far as the addiction reason was concerned. Other research papers have reported grade-related differences. The findings of Đogaš and Jerončić [71], as a case in point, showed a statistically significant difference among the students in different grades. Overall, understanding the reasons why students use their mobile phones during the lecture hours contributes a lot to understanding the behaviors of students and to what extent these causes may affect their academic performance and well-being.

## 7. Conclusions

This study investigated the use of mobile phones during lecture hours and their contribution to learning as perceived by the students. More specifically, it has addressed how these perceptions may vary among students at different grade, age, and gender groups. The limitations of each questionnaire have contained the participants specified time, dishonest answers, unanswered questions, differences in understanding, interpretation for each participant, difficulties in the interpretation of participant's analysis, lack of personalization, and unconscientious responses that might have affected the results of this quantitative computer-based analysis. According to the findings of this study, the primary reason for using mobile phones during lecture hours was class-related use, followed by boredom and emergency issues. These findings provide insights into how the presence of mobile phones in classrooms may affect the traditional student–teacher dynamic, and the factors that may reduce the effective use of these devices in the classroom. It was also found that students' use of mobile phones had no significant correlation to a particular gender or age group. The only significant difference was found in the students' grade concerning the addiction category. Although these findings raise researchers' and instructors' awareness about the use of mobile phones among different groups of students in general and its application at the university level in particular, the results should be interpreted with care; in this way, the sample was not representative of the population, and this makes the generalizability of findings to other contexts and situations limited.

## 8. Recommendation and Future Works

It is of note that, although this study and many previous studies have yielded promising results on the use of mobile devices as practical tools to support teaching and learning [72], and most of them indicate that these tools increase students' motivation and engagement in the learning activities, and improve students' achievements [73,74], there are three areas of concern which require further attention and investigation. First, despite their high potentials, many disadvantages have been attributed to mobile phones, and it is essential to conduct studies to decide how to reduce the adverse effects of their use in the classroom. Second, there is little information about how personal mobile devices can be incorporated into the classroom as significant educational devices. Third, more studies are required to address the causes and motivations for mobile phone use among different varieties of users. Therefore, researchers and practitioners interested in this area are advised to address these gaps in the literature.

**Supplementary Materials:** The following are available online at <http://www.mdpi.com/2071-1050/12/20/8345/s1>, Table S1: questionnaire sample.

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